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Indian Standard

METAL SPRAYING FOR PROTECTION OF IRON AND STEEL — RECOMMENDED PRACTICE

(First Revision)

भारतीय मानक

लोह और इस्पात के संरक्षण के लिये धातु फुहार को रीति संहिता

(पहला पुनरीक्षण)

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January 1990 **Price Group 2**

Hot Dip Sprayed and Diffusion Coatings Sectional Committee, MTD 23

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards on 10 August 1989, after the draft finalized by the Hot Dip Sprayed and Diffusion Coating Sectional Committee had been approved by the Metallurgical Engineering Division Council.

This standard was first issued in 1972. This revision has been prepared keeping in view the rapid advances with regard to the procedure and application of metal spraying during the past decade.

An important field of use of metal spraying is the application of coatings of zinc or aluminium on iron and steel equipment and structures for protecting them against corrosion in various environments including marine and industrial atmospheres and fresh and salt water exposure. Zinc or aluminium in the form of wire or powder is fed into an oxyfuel gas flame in a special tool and the molten metal is atomized in a stream of compressed air and sprayed on to the previously prepared surface. The process is useful for shop as well as site work and there are no limitations on the size of articles that can be treated.

This standard should be used in conjunction with IS 5905 : 1989 'Sprayed aluminium and zinc coatings on iron and steel' — Specification' which specifies the material used for spraying, thickness and other requirements for metal sprayed coatings on iron and steel for protection against corrosion.

Indian Standard

METAL SPRAYING FOR PROTECTION OF IRON AND STEEL — RECOMMENDED PRACTICE

(First Revision)

1 SCOPE

1.1 This standard recommends procedures for application of coatings of aluminium or zinc by spraying on iron and steel for protection against corrosion.

2 REFERENCES

2.1 The following Indian Standards are necessary adjuncts to this standard:

IS No.	*Title*
IS 460 (Part 1) : 1985	Specification for wire cloth test sieves (*third revision*)
IS 4683 : 1968	Specification for chilled iron shot and grit for use in foundries
IS 5905 : 1989	Specification for sprayed aluminium and zinc coatings on iron and steel

3 RECOMMENDED PROTECTIVE SCHEMES

3.1 The basis of recommendation and the recommended scheme have been given in IS 5905 : 1989. However attention should be given to the nature and severity for exposure conditions, nature of the structure, its utility, expected life and maintenance schedule. It is rather difficult to recommend unequivocally the best system for a particular situation. At best systems which are expected to give a reasonably good performance may be suggested. The user has to select the best combination of the protective scheme depending on the recommendations made on his own accumulated experience and overall economics.

4 SURFACE PREPARATION

4.1 The bend between the sprayed metal and the surface to be treated is mainly due to the mechanical inter-locking of the first layer to the interstices of the roughened surface. Therefore, much attention should be paid to the preparation of the surface besides the proper choice of the coating material and its thickness.

For attaining a high degree of adhesion, immediately before spraying, the surface shall be free from traces of oil, grease, scale, rust, moisture or other foreign matter and suitably roughened (*see* **4** of IS 5905 : 1989) to facilitate adequate mechanical keying.

Blasting with abrasive material is an effective method of preparation. It removes all foreign material except oil and grease and leaves a roughened surface suitable for spraying.

4.2 Cleaning Prior to Blasting

Grease and oil should be removed from the area to be sprayed as well as the adjoining areas. If these are not removed from the surface prior to grit blasting they may contaminate the grit. On recirculation of the grit, the surface may be recontaminated and this will prevent attainment of the required standard of surface cleanliness.

4.2.1 A chemical solvent, such as trichloroethylene or carbon tetrachloride or any other suitable cleaning agent, or heating or a combination of solvent cleaning and heating could be employed for cleaning the surface.

4.2.2 The material used for cleaning is not so important as the final result should be a thoroughly clean surface without any oil, grease or alkali left over.

4.3 Abrasives for Blastings

Silica sand or special crushed slag, flint or garnet is used outdoors where the abrasive cannot be reclaimed and re-used. It should be hard, sharp and angular as mignt be produced by crushing. Round silica sand or similar materials should never be used.

NOTE — Sand blastings with silica sand dust is recommended in special cases only where adequate and effective protective devices are used to prevent the inhalation of silica dust.

4.3.1 Crushed chilled iron or steel grit is most commonly used where the abrasives may be reclaimed. Round steel shot or rounded grit should never be used. Aluminium oxide is also used where it may be reclaimed. All abrasives should be clean, dry and free from oil or other contaminants.

4.3.2 *Sizes*

a) *Sharp, coarse sand*

The grain size of sand should be between 600 µm and 1 700 µm and a minimum of 40 percent should be retained on a 850 µm sieve, conforming to IS 460 (Part 1) : 1985.

b) *Chilled iron grit*

Grit Grade GC-100 to GC-42 (*see* IS 4683 : 1968) should be issued.

c) *Aluminium oxide*

The grain size should be between 300 µm and 850 µm ; a minimum of 40 percent should be retained on a 425 µm sieve conforming to the relevant part of IS 460 (Part 1) : 1985.

4.4 Blasting Methods

Common blasting methods in use of metal spraying are pressure blasting and centrifugal blasting (airless blasting). While pressure blasting is suitable for manual or mechanized operation, centrifugal blasting is used only as a mechanized system.

4.4.1 *Manual Pressure Blasting*

Pressure blasting is the process most often used for preparing surfaces prior to metal spraying. It is particularly useful for large area job, work of varied shapes, which have to be treated manually in works blast room. For site work blasting, it is almost universally in use. The air pressure at the grit container should not be less than 4 kg/cm^2. Details of the equipment may, however, be procured from the manufacturer.

4.4.1.1 *Blasting technique*

Manual blasting should systematically cover the entire surface to be treated, by traversing the nozzle at a fairly constant speed in straight paths, each succeeding pass partially overlapping the preceding one and exposing clean metal. The nozzle distance when treating materials like steel should be 150 to 250 mm. The angle of blasting is generally 15° to 30° from normal to the blasted surface. The blast nozzle should be replaced when diameter of the orifice has been increased for 25 percent by wear.

4.4.1.2 Areas not to be treated should be marked off with suitable tape or suitable masking compound.

4.4.1.3 It is essential that compressed air should be dry and free from oil vapours.

4.4.2 *Mechanized Blasting Method*

Fully mechanized blasting systems are possible either with pressure blasting or with the method known as 'centrifugal blasting' or 'airless blasting' in which abrasive particles are projected on the surface to be treated from rapidly rotating impellers. Both these methods are employed when a large number of components of similar type are to be treated.

4.4.2.1 In mechanized pressure blasting, a large number of parts pass on an endless belt, turn table or other conveying devices through a cabinet or chamber fitted with a number of blasting nozzles.

4.4.2.2 Centrifugal blasting equipment is suitable for large volume repetitive applications but have to be specially designed for complex steel sections. This method has, however, limited applications in the metal spraying industry, where it is not usual for work to be all of the type.

5 SPRAYING PROCEDURE

5.1 Spraying is done with a metal spraying gun or pistol. The types of metal spraying guns commonly used are the gas or flame type wire spraying gun, gas or flame type powder spraying gun and the electric arc type wire spraying gun.

5.1.1 When the gas or flame type of gun is used, supply of oxygen and recommended fuel gas, for operating the equipment efficiently should be arranged. Fuel gases commonly used are acetylene and propane (LPG). In addition, an adequate supply of dry compressed air, free from traces of oil at recommended pressure should be provided where necessary.

Ancillary equipment such as air or gas pressure regulator and hoses and necessary safety aids should be available.

Use of flowmeters for oxygen and fuel gas is recommended since it assists in setting and maintaining the correct spraying conditions.

5.1.2 For the electric arc gun, a powder source of adequate capacity and duty cycle, with desirable volt ampere characteristics to maintain a stable arc condition should be provided.

Usually a motor generator or transformer rectifier type of power source is used.

5.1.3 For the wire feed guns provision should be there for suitable adjustments of the feed speed of the wire.

5.2 Spraying Procedure

5.2.1 The metal spraying shall be carried out after the surface has been prepared by abrasive blasting, within a period such that the metal is sprayed on to a sand-blasted or grit-blasted surface which is still clean, dry and not visibly oxidized. This time period should be as short as possible and should not exceed 2 to 12 hours, depending on local conditions. In a humid or marine atmosphere, the maximum time interval may have to be reduced to 2 hours or even less. In rain weather, the operation should be carried out under cover.

If a deterioration in the surface to be coated is observed, it is necessary that the preparation treatment to be repeated on the surface to be coated.

5.2.2 The gas or flame spraying pistol or gun should be lighted and adjusted with the spray directed away from the work.

5.2.3 The operating conditions, such as wire speed, air pressure, gas pressure, flame conditions, voltage and current levels recommended by the manufacturer of the equipment should be strictly adhered to.

5.2.4 In particular the practice of increasing spraying rates over those recommended, by increasing gas pressure is to be avoided since this could rise to poor results.

5.2.5 During the spraying operation, gun should be held at a distance from the surface as recommended by the equipment manufacturers (depending upon the equipment and size of the wire being used) and coating is applied by uniformly traversing the gun in a regular manner.

5.2.5.1 Approximate thickness of coating per pass should be 25-50 μm till the average specified thickness is achieved.

5.2.6 For most of the jobs spraying can be done manually but mechanized spraying may be adopted for repetitive jobs on large components of regular shape.

6 SEALING/TOP COATING

6.1 Sealing of Sprayed Metal Coatings

Sealers are low viscosity fluids containing an inert resin binder in sovent, that may be clear (unpigmented) or pigmented and coloured. The sealers impregnate the natural pores in the sprayed metal improving the appearance and reduces the retention of dirt. Hence, the coating keeps clean, has longer life and is easy to maintain. At the same time the electro-chemical sacrificial action of the metal coating which prevents rusting in the event of mechanical damage, remains fully operative.

6.1.1 *Material for Sealing*

Extreme care should be taken in selection of material for sealing. The material used should be compatible with the sprayed coating of zinc or aluminium. Materials which react with these metals and cause early blistering and failure should be avoided. Suitable blend or vinyl chloride acetate co-polymers with or without non-saponifiable plasticizers, two component phenolic or epoxy systems are examples of materials used for sealing. Chlorinated rubber is not satisfactory sealer for aluminium and zinc coating.

6.1.2 *Application*

Sealing and finishing coats should be applied to clean dry surfaces. These coatings may be applied by brush or spray. If sprayed, pressure-type spray guns should be used. Any oil grease or other contamination should be removed by thoroughly washing with a suitable thinner until no visible traces exist and the surface should be allowed to dry thoroughly before applying the sealers. Coating should be applied heavy enough to produce a thoroughly wet appearance. First coats should be properly thinned to provide complete penetration of the metallized zinc or aluminium coating.

6.2 Painting of Sprayed Metal Coatings

The practice of applying a full multicoat paint system on top of sprayed metal is generally not necessary.

6.2.1 Painting over sprayed metal is recommended only when:

a) the required decorative finish could be obtained only by painting.

b) additional abrasion resistance is required.

c) the metal is subjected to direct attack by specific chemicals; or

d) the environment is very acidic or very alkaline.

6.2.2 Finishing paints, pigmented with micaceous iron oxide, silica, graphite or aluminium in a suitable oleo-resinous medium have good protective properties and are easy to apply. For chemical environments the complete paint system should be of chemical resistant paints, the type chosen shall be determined by the nature and severity of attack to which job is exposed.

6.2.3 One or two coats of paint is sufficient. It may be effected by brush or spray, if sprayed, pressure type spray guns should be used.

6.2.4 Wash primers/etch primers may be used on the metal coating before applying sealers to improve adhesion between the metal spray coating and sealer or paint.

7 SAFETY PRECAUTIONS

7.1 The normal precautions against fumes and dust hazards, such as wearing of masks and proper ventilation should be used.

7.2 For indoor spraying on smaller jobs, it is preferable to use a spray booth to collect zinc or aluminium powders released during spraying.

7.3 Any safety measures or precautions suggested by the equipment or paint manufacturer should be observed, and if in doubt, should be clarified.